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ABSTRACT

This study was an initial exploration of the relationship between coordinated interpersonal timing and quality of mother-toddler attachment. Eleven primiparous white, middle class mothers and their children (8 males, 3 females) participated. Mothers averaged 32 years of age and toddlers averaged 18.10 months. A prerecorded dyadic free-play session was coded by an entirely automatic microanalytic technique using the Automatic Vocal Transaction Analyzer, which times the sequence of vocal sounds and silences in the interaction. Time-series regression was used to determine the extent of temporal coordination. Attachment security was measured by the mothers' completion of the Attachment Q-Sort. Results revealed that: (1) the higher the infants' pause coordination with their mothers, the less secure their relationships; (2) infants had a less secure attachment relationship to older mothers; and (3) mothers engaged in more coordination of their vocalizations with those of their older infants. (Contains 23 references.) (Author/KDFB)

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# Mother-Toddler Attachment and Coordinated Interpersonal Timing During Play Interactions: A Preliminary Study[1]

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The study was an initial exploration of the relationship between coordinated interpersonal timing and quality of mother-toddler attachment. Eleven primiparous white, middle class mothers and their children (8 males, 3 females) participated. Mothers averaged 32 years of age and toddlers averaged 18.10 months. A prerecorded dyadic free-play session was coded by an entirely automated microanalytic technique that timed the sequence of vocal sounds and silences in the interaction. Time-series regression was used to determine the extent of temporal coordination. Attachment security was measured by the Attachment Q-Set (mother's sort). Results revealed that (a) the higher the infants' pause coordination with their mothers, the less secure their relationships, (b) the infants had a less secure attachment relationship to older mothers, and (c) the mothers engaged in more coordination of their vocalizations with those of their older infants.

vocal interaction temporal coordination free-play automated microanalysis

According to Bowlby (1969), attachment relationships evolve via caretaker-infant interaction, particularly during the first year of the infant's life. This caretaker-infant bond is contingent upon the caretaker meeting the infant's needs. Thus, the attachment relationship is the result, at least in part, of how caretakers respond to their infants' cues for safety, comfort, and social interaction (Bowlby, 1969; Harlow & Harlow, 1962). In addition, a caretaker-infant interaction is specific to an individual dyad, *i.e.*, it is unique for a given caretaker-infant pair (Ainsworth et al., 1978; Sroufe & Waters, 1977). Attachment theory also states that once this attachment relationship is formed, the infants' behaviors will be organized around their interactional style (Bowlby, 1969).

Despite the variation of interactional style, Ainsworth, Bell, & Stayton (1974) postulated that the ideal dyadic interaction involves a high level of maternal sensitivity. This sensitivity includes the mothers' accurate perceptions and interpretations of their infants' signals (Ainsworth, Blehar, Waters, & Wall, 1978). Such maternal sensitivity cultivates synchronous, reciprocal, and jointly satisfying interactions that foster the development of a secure attachment relationship. Maternal insensitivity--the failure to accurately perceive and respond to her infant's signals--leads to poor timing, mutually unsatisfying interaction, and, thus, insecure attachment.

This premise of Ainsworth has generated a great deal of research concerned with maternal sensitivity and quality of mother-infant attachment. In a review of the literature on maternal sensitivity, Isabella, Belsky, and von Eye (1989) noted that empirical support for the influence of maternal sensitivity on the quality of mother-infant attachment has relied on subjective ratings of maternal sensitivity (Ainsworth et al., 1971, 1974; Benn, 1985;

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Grossman, et al., 1985; Isabella, 1990). However, attempts to operationalize maternal sensitivity through more detailed observation have not usually succeeded (Belsky & Isabella, 1988; Lamb, et al., 1984). There is, then, a need for more objective measures of maternal sensitivity. This dilemma has lead several researchers (Jaffe, Feldstein, Beebe, Crown, Jasnow, Fox, Anderson, & Gordon, 1991) to begin examining maternal sensitivity in terms of the conversational interaction of mothers and infants. Such research is based on the underlying assumption that maternal responsiveness to an infant's cues involves coordination in the timing of their "dialogue." However, it has been postulated that "...when we examine temporal information, we are actually examining the entire 'package' of social behavior" (Feldstein, Jaffe, Beebe, Crown, Jasnow, Fox, & Gordon, 1993, p. 456). It might be, then, that the temporal coordination of mother-infant interaction is related to the evolving attachment relationship between mother and infant.

Previous research in this area lends some support for this notion. Although several approaches have been taken to assess coordination, most of them do not involve timing, or are concerned with the timing of a mix of gestural, body, and vocal behavior. Among those that have examined timing, Isabella, Belsky, and von Eye, in their 1989 study, utilized microanalytic techniques in operationalizing mother-infant interactions and found that synchronous dyadic temporal co-occurrences at 1 and 3 months were predictive of secure attachments at 12 months. Also, asynchronous temporal co-occurrences were predictive of insecurity at 12 months. In a replication of this study, Isabella and Belsky (1991) again found that securely attached dyads at 12 months engaged in well-timed, reciprocal interactions at 3 months and also at 9 months. Insecure dyads at 12 months were characterized by interactions in which mothers were unresponsive or intrusive to infant signals at 3 and 9 months. Although much of this research is highly labor-intensive, it does suggest that timing is an important component of the mother-infant relationship. The present pilot study examined the possibility that the measurement of coordinated interpersonal timing by an automated system using an explicit, objective model of dyadic vocal interaction (Feldstein & Welkowitz, 1978) may provide a more efficient and accurate estimate of maternal sensitivity. Coordinated interpersonal timing is defined here as occurring when the temporal pattern of each person's vocal behavior is predictable from that of the other (Feldstein et al., 1993). The microanalytic temporal coding of the behavior is accomplished by a specialized computer system called the Automatic Vocal Transaction Analyzer, or AVTA (Jaffe & Feldstein, 1970).

Research utilizing AVTA has offered support for the role of temporal coordination in security of attachment. In a study of temporal coordination and attachment, Jaffe, Feldstein, Beebe, et al. (1991) found a curvilinear relationship between interpersonal timing at 4 months and attachment security at 12 months. Interactions characterized by high coordination ( *i.e.*, over-sensitivity or hypervigilance on the part of mother) as well as low coordination ( *i.e.*, under-sensitivity or unresponsiveness on the part of mother) predicted insecure attachment. A similar study using AVTA also found curvilinear relations between attachment security at 12 months and interpersonal timing at 4 months, such that high and low coordination were significantly associated with more insecure attachment relationships as measured by the Strange Situation (Feldstein, Crown, Beebe, & Jaffe, 1994). This research suggests that the interpersonal timing of mothers and infants when the latter are 4 months old is predictive of the quality of infant-mother attachment when the infants are 12 months old. The present study was an effort to explore the possibility that the findings of Jaffe et al. (1990) and Feldstein et al. (1994) can be partially replicated with 18-month-olds. Based partly upon those findings, we speculated that temporal coordination in a mother-toddler free-play session obtained at 18 months may be related to security of attachment, as measured by the Attachment Q-Set (AQS) (Waters & Dean 1985), also obtained at 18 months.

## METHOD

### Participants

Twenty primiparous mothers and their children were successfully recruited for a larger study by advertisements in local papers and/or fliers. However, technical recording problems marred nine of the audiotapes such that they could not be used. All remaining mothers were at least 20 years of age ($M$= 32.00, s=6.75) and married or living with their child's father. They were middle class, college-educated caucasians from the Baltimore metropolitan area. The toddlers ranged from 16 to 20 months of age ($M$=18.10, s=1.25) and 8 were male. The mother-toddler dyads voluntarily participated in the study and the mothers signed informed consent forms for themselves and their child prior to their participation. For their involvement in the study, participants received a videotape of the free-play session that was filmed during the laboratory visit as well as a token fee of $20.00.

### Measures

*Temporal behavior*. The vocal behaviors of the free-play segment on audiotape were analyzed by the input of the mother's and the child's audio signals into the AVTA system (Jaffe & Feldstein, 1970). The AVTA system is comprised of a hardware analog-to-digital converter that determines whether the audio signal from each party is on or off. The analysis does not take into account the frequency or intonational aspects of the speech. Once the signals are measured, AVTA transforms and digitally stores the data as a sequence of numbers that correspond to the following speech patterns: The signals of one person talking alone are coded as 1; those of the other person talking alone are coded as 2; when both persons are talking simultaneously, their signals are coded as 3; and when neither is talking, their mutual silence is coded as 0. The AVTA program then converts this sequence of numbers into a set of vocal parameters (Jaffe & Feldstein, 1970; Feldstein & Welkowitz, 1987) and provides descriptive statistics for a prespecified time unit (Feldstein et al., 1993).

The vocal parameters AVTA generates are *speaking turns, vocalizations, pauses, switching pauses,* and *simultaneous speech*. A *turn* is initiated the instant a participant vocalizes, and is sustained until the other participant begins vocalizing alone. A *vocalization* is any speech from either party that is uninterrupted by silence. A *pause* is the occurrence of mutual silence that is bounded by vocalizations of the same participant. A *switching pause* is a silence that has been initiated by one participant and terminated by the other (Feldstein & Welkowitz, 1978). Simultaneous speech occurs when the two participants talk at the same time. It can be terminated by an interruption of the speaker who has the turn or by the continuation of the speaker who has the floor. The two types of simultaneous speech are *interruptive* and *noninterruptive simultaneous speech*, respectively.

*Attachment Q-Set*

Attachment security was assessed by the Attachment Q-Set (AQS), Version 3 (Waters, 1987). This measure consists of 90 behaviorally descriptive items that are sorted into nine piles according to a predefined distribution. It provides an ipsative summary of a toddler's secure-base behaviors in a naturalistic context. The mother or observer is instructed to sort the items that are most characteristic of the child at one end of the distribution (piles 9, 8, and 7), and items that are most uncharacteristic of the child at the other end of the distribution (piles 1, 2, and 3). Items deemed neither like nor unlike the child are placed in the middle of the distribution (4, 5, and 6). The placement of a particular item in the distribution constitutes the score for that item. These scores are then correlated with a criterion sort (*i.e.*, a sort completed by experts of the prototypically most secure child) using a product-moment correlation. This

correlation coefficient is the final Q-Set security score, and the higher the score, the more secure-based behaviors are exhibited by the child in the home. The validity of the Attachment Q-Set has been established with the Strange Situation (Vaughn & Waters, 1990; White & Feldstein, 1994). Reliability ($r$ = .80) of mothers' sorts has been established with the sorts of objective observers (Waters & Dean, 1985), and mothers have been shown to have higher agreement with the Strange Situation than observers (White & Feldstein, 1994).

**Procedure**

Upon expression of interest in the study, the mothers of the dyads that met the criteria for the study were given a brief overview of the study and then invited to participate. After their verbal consent, dyads were scheduled for a morning lab visit.

Participants were met on campus at 8:00 am by the project coordinator and escorted to UMBC's Interpersonal Communication Laboratory. The coordinator then explained the laboratory visit to the mother in detail and asked the mother to sign the appropriate consent forms. Next, mother and child were wired with portable microphones.

During the laboratory visit, mother and child were audio- and videotaped during a 15-minute free-play session. The mother was instructed to play with her child as she does at home. The free-play room in the laboratory is designed to simulate a comfortable living-room environment, complete with couch, chairs, and a low circular table with toys placed on top. This room also is equipped with a two-way mirror utilized for observing and recording purposes.

When they completed the laboratory visit, mothers were given a list of the 90 behaviors that made up the Attachment Q-Set items and were asked to observe their child for the occurrence of these behaviors throughout the next two weeks. The mothers were then scheduled for a home visit within 10-14 days following the laboratory visit. At the time of this scheduled appointment, the Attachment Q-Set (Waters, 1987) was completed by the mother with the help, when needed, of a trained research assistant.

## RESULTS

A time-series regression (TSR) analysis (Ostrom, 1978) was computed for each vocal parameter to assess the degree of coordinated interpersonal timing for each mother-toddler dyad. The TSR yields squared partial cross-correlations, called coefficients of coordination (CC), that represent the degrees of coordination. Because of the small *N*, our analyses were limited to descriptive statistics and correlation coefficients.

A correlation matrix was computed using the mothers' six coefficients of coordination and the infants', plus the mothers' and infants' ages and the AQS. Of the 225 resulting coefficients, only three that were relevant to the present study were significant. The most pertinent is the correlation between infant pauses and the AQS, which yielded a coefficient of -.597 ($p$ = .05). Thus, as the infants' pause coordination with that of the mothers increased, the quality of their attachment became less secure. The small *N* did not permit analyses of quadratic components in the relation between the Q-Sort and each of the vocal measures. However, a scattergram of the relation between the pause CCs and the AQS is suggestive of a curvilinear component.

The other two coefficients are also of interest. One indexes the relation between the mothers' ages and the AQS ($r$ = -.762, $p$ = .01) and the other between the infants' ages and the extent to which the mothers coordinate their vocalizations ($r$ = .803, $p$ = .003). The first suggests that the older mothers have a less secure attachment relationship to their infants and the second, that the mothers engage in more coordination of their vocalizations with those of their older infants.

Table 1 presents the descriptive statistics of the vocal parameters.

## DISCUSSION

The results do not fully replicate the earlier results of Jaffe and his colleagues (Jaffe, Feldstein, Crown, Jasnow, Fox, Anderson, & Gordon, 1991), and the one significant correlation among all those computed may be a function of chance. It is, however, a result that makes sense in the light of those previous findings. Those mothers and infants who engaged in high coordination were those found to be in the less secure categories of the Strange Procedure. Indeed, the tightest coordination (possibly vigilance) on both the mothers' and infants' parts was found in the D category (Jaffe, Feldstein, Beebe et al., 1991).

Table 1

*Means and Standard Deviations of the Vocal Measures and Attachment Q-Sort*

| | Vocal Measures | *N* | Mean | Standard Deviation |
|---|---|---|---|---|
| Mothers | Speaking Turns | 11 | .038 | .054 |
| | Vocalizations | 11 | .079 | .040 |
| | Pauses | 11 | .087 | .025 |
| | Switching Pauses | 10 | .064 | .044 |
| | Noninterruptive SS | 9 | .078 | .066 |
| | Interruptive SS | 10 | .049 | .041 |
| Toddlers | Speaking Turns | 11 | .088 | .103 |
| | Vocalizations | 11 | .070 | .055 |
| | Pauses | 11 | .071 | .033 |
| | Switching Pauses | 10 | .109 | .056 |
| | Noninterruptive SS | 9 | .092 | .078 |
| | Interruptive SS | 10 | .150 | .140 |

Note. The entries in the cells are the average degrees of temporal coordination ($r^2$). Those for the mothers represent the degree to which they coordinated with their toddlers, whereas those for the toddlers represent the degree to which they coordinated with their mothers.

The absence of other significant findings may be a function of the fact that the infants' capacities at 18 months, *i.e.*, their ability to walk and talk and venture away from their mothers, may make close coordination with the mother less necessary. Or given the small sample size, their absence may be a function of inadequate power.

Although it could not be verified statistically, inspection of the relevant scatterplot suggested that the expected curvilinear relationship between interpersonal timing and security of attachment may exist when both variables are measured when the infants are 18 months old. While previous research found such a relationship when interpersonal timing was assessed early in infancy (*i.e.*, 6 weeks and 4 months) and attachment security was measured at 12 months, it may be that such a relationship remains salient later in toddlerhood. It should be noted that a more extensive investigation of the role of coordinated interpersonal timing in attachment security is in progress.

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